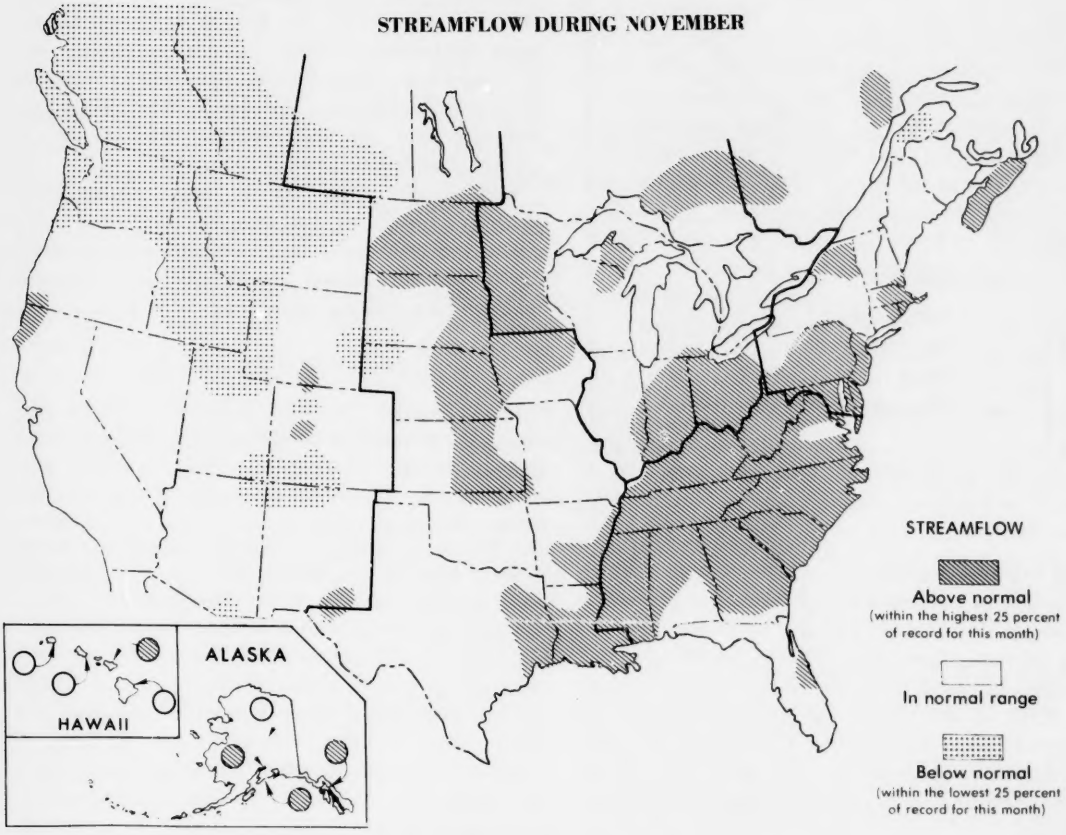
WATER RESOURCES REVIEW for NOVEMBER 1979

UNITED STATES
DEPARTMENT OF THE INTERIOR
GEOLOGICAL SURVEY

CANADA
DEPARTMENT OF THE ENVIRONMENT
WATER RESOURCES BRANCH



STREAMFLOW AND GROUND-WATER CONDITIONS

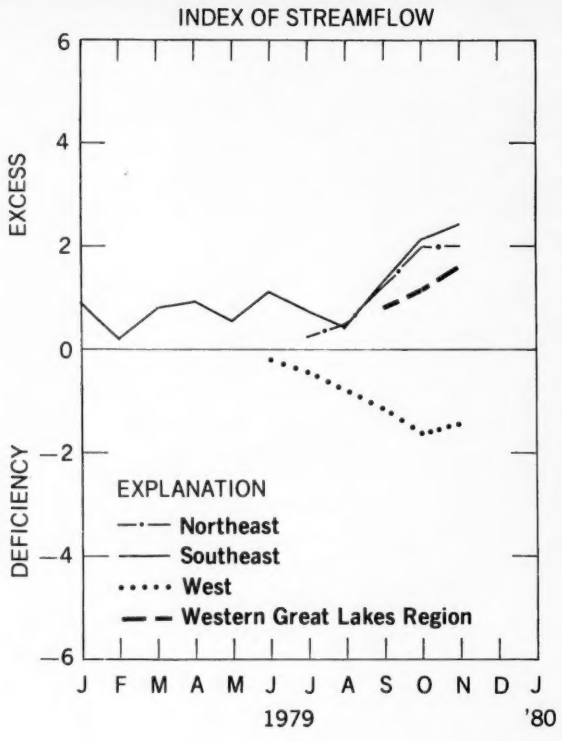
Streamflow generally increased in most areas of the United States, but decreased in Alaska, Florida, several northeastern States, and southwestern Canada. Flows were variable in southeastern Canada, most Rocky Mountain States, and several of the mid-Atlantic States.

Below-normal streamflow persisted in parts of Colorado, New Mexico, Utah, and in a large area in and adjacent to Idaho. In the Pacific Northwest, monthly mean flows remained in the below-normal range for at least 6 consecutive months at several index stations and storage for power in the Columbia River basin was much below average in several key reservoirs.

Monthly mean flows remained in the above-normal range in parts of most States and Provinces in the Northeast, Southeast, and Western Great Lake Regions. Monthly and/or daily mean flows were highest of record for the month in parts of Alaska, Indiana, Iowa, Michigan, Minnesota, Nebraska, North Carolina, South Dakota, and Tennessee. Flooding occurred in Hawaii, Indiana, Kansas, Louisiana, Mississippi, Missouri, New York, North Carolina, and Oklahoma.

Ground-water levels rose in Maine, Rhode Island, and in much of Connecticut, and locally in other parts of the Northeast Region. Declines occurred in New Jersey and southeastern Pennsylvania. Levels were mostly near average, but were above average in southern New England. In the Southeast Region, levels declined but were above average in West Virginia, Kentucky, and Virginia. Levels declined in Florida but were mixed with respect to average. Trends were mixed elsewhere in the Southeast, and levels were above and below average. In the Western Great Lakes Region, trends were mostly mixed, and levels were generally above average. In the Midcontinent, rising levels prevailed, but were mixed with respect to average. In the West, mixed trends prevailed, and levels were above and below average.

New high ground-water levels for November occurred in southern California, Michigan, Ohio, Utah, Virginia, and West Virginia. A new alltime high was recorded in Kentucky. New November lows were noted in Arizona, Arkansas, Idaho, Nevada, New Mexico, Texas, and Utah. New alltime lows occurred in Arizona and Texas.



The index of streamflow is computed by multiplying the percent of a region that is deficient or excessive by the average duration of deficiency or excess. Thus the index of streamflow excess for the Southeast during November increased to a value of 2.4 when 80 percent (i.e., 0.80) of the area in the Southeast Region was excessive for an average duration of 3 months. The index of streamflow deficiency in the West was −1.4 as below-normal streamflow persisted in most of the Pacific Northwest.

NORTHEAST

[Atlantic Provinces and Quebec; Delaware, Maryland, New York, New Jersey, Pennsylvania, and the New England States]

Streamflow increased seasonally in Connecticut, Maine, New York, Rhode Island, and Vermont, decreased in Maryland, Massachusetts, and New Hampshire, and was variable elsewhere in the region. Monthly mean flows remained in the above-normal range in parts of Connecticut, Massachusetts, New Jersey, New York, Maryland, Pennsylvania, and Rhode Island. Mean flows decreased into the below-normal range in part of Quebec. Flooding occurred in New York.

Ground-water levels rose in Maine, Rhode Island, much of Connecticut, and in a few other areas. Levels declined in New Jersey and southeastern Pennsylvania. Levels were near average except in a few areas such as southern New England where levels were above average.

STREAMFLOW CONDITIONS

In northeastern New York, runoff from intense rains November 26 resulted in moderate flooding and record high stages and discharges on several streams. Near Elizabethtown, in Essex County, several lives were lost when a section of State Route 9N was washed out by The Branch, a tributary to the Bouquet River. At the Bouquet River at New Russia, the stage was the highest since records began in 1949. The peak discharge of 9,800 cfs on November 26 at Bouquet River at Willsboro (drainage area, 275 square miles) was highest since 1924 and equal to that of a 40-year flood. On East Branch Ausable River at Au Sable Forks (drainage area, 198 square miles), in Essex County, the peak discharge of 15,000 cfs was third highest of record and equal to a 50-year flood. Other streams in the area experienced only minor peaks of less than a 2-year recurrence interval.

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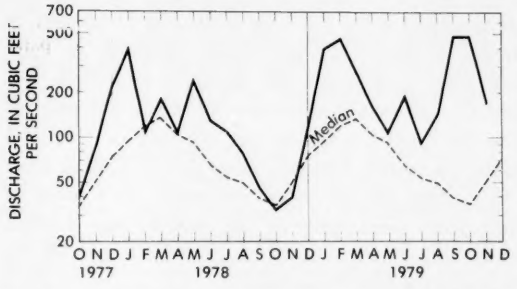
Also in that part of the State, monthly mean flow of Hudson River at Hadley increased seasonally and remained in the above-normal range for the 3d consecutive month. In northern New York, mean flow of West Branch Oswegatchie River near Harrisville increased sharply and remained in the above-normal range and was 165 percent of median. Elsewhere in the State, mean flows generally increased seasonally, remained above median, but were within the normal range.

In southwestern Pennsylvania, flow of Monongahela River at Braddock decreased, contrary to the normal seasonal pattern of increasing flows, but remained in the above-normal range for the 4th consecutive month. In the southeastern part of the State, the monthly mean discharge of 43,700 cfs at Susquehanna River at Harrisburg (drainage area, 24,100 square miles) was over twice the November median.

In central Maryland, where monthly and daily mean discharges of Seneca Creek at Dawsonville were highest of record for October, monthly mean flow remained above the normal range for the 4th consecutive month and was more than three times the November median discharge. (See graph.) In the eastern part of the State, mean flow of Choptank River near Greensboro decreased, contrary to the normal seasonal pattern, but remained in the above-normal range for the 3d consecutive month and was 340 percent of median.



Monthly mean discharge of Seneca Creek at Dawsonville, Md. (Drainage area, 101 sq mi; 262 sq km)

In New Jersey, monthly mean flows generally decreased, contrary to the normal seasonal pattern of increasing flows, and remained in the above-normal range, as a result of high carryover flow from October and increased runoff from rains early in November. For example, along the Pennsylvania-New Jersey border, where monthly mean discharge of Delaware River at Trenton, N.J., was 4 times median in October, mean flow decreased, was 162 percent of median in November, and remained in the above-normal range for the 3d consecutive month. Similarly, in the southern part of the State, monthly mean discharge of Great Egg Harbor River at Folsom also decreased, contrary to the normal seasonal pattern, was about 1½ times median and remained in the above-normal range for the 3d consecutive month. In northern New Jersey, mean flow of South Branch Raritan River near High Bridge increased seasonally and remained in the above-normal range for the 7th consecutive month.

In Connecticut, monthly mean flows increased seasonally and remained above median throughout the State. In the northeastern part of the State, mean flow of Mount Hope River near Warrenville increased to twice the November median as a result of increased runoff from rains on the 3d, 12th, and 27th, and remained in the above-normal range for the 4th consecutive month.

Similarly, in Rhode Island, monthly mean flow of Branch River at Forestdale increased to 192 percent of median and was in the above-normal range for the 6th time in the past 7 months.

In central Massachusetts, mean flow of Ware River at Intake Works near Barre decreased, contrary to the normal seasonal pattern, but remained in the above-normal range for the 5th consecutive month and was 230 percent of median.

In central New Hampshire, monthly mean flow of Pemigewasset River at Plymouth decreased to 95 percent of median and was in the normal range following 2 consecutive months of flow in the above-normal range. In the southeastern part of the State, mean flow of Lamprey River near Newmarket remained in the above-normal range.

In Maine and Vermont, monthly mean flows at all index stations increased seasonally and were above median but within the normal range.

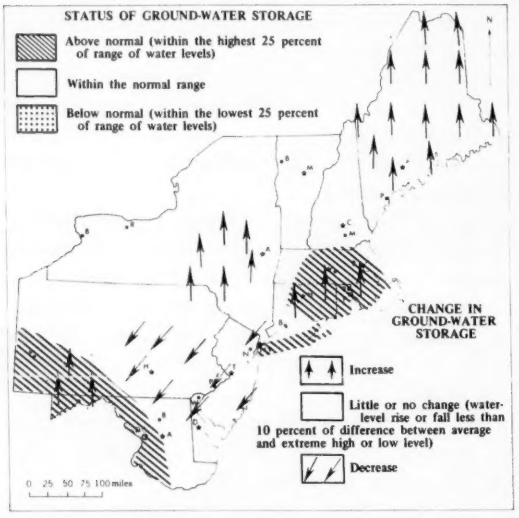
In southern Nova Scotia, streamflow increased seasonally and remained in the above-normal range. For example, monthly mean discharge continued to increase seasonally at LaHave River at West Northfield and St. Mary's River at Stillwater and remained in the above-normal range for 4 and 2 consecutive months at the respective sites. Elsewhere in the Atlantic Provinces, mean flows at index stations were close to the November median flows and were within the normal range.

In eastern Quebec, flow of Matane River near Matane decreased, contrary to the normal seasonal pattern of increasing flows, and was below the normal range for the first time since June 1979. Also in eastern Quebec, high carryover flow from October held monthly mean discharge of Outardes River at Outardes Falls in the above-normal range for the 4th consecutive month. In the western part of the Province, monthly mean discharge in Harricana River at Amos increased seasonally to 184 percent of median and remained in the above-normal range for the 7th consecutive month.

Elsewhere in the province, monthly mean flows at index stations were near or slightly below median but within the normal range.

GROUND-WATER CONDITIONS

Ground-water levels rose in most of Maine and continued to rise in several areas, including Rhode Island, much of Connecticut, Long Island, N.Y., northeastern Pennsylvania, and western Maryland. (See map.) Levels declined in most of New Jersey and southeastern Pennsylvania. In most of the region, levels near end of month were near average except for above-average levels in much of southern New England and also on Long Island, N.Y., and in south-central and western Maryland.



Map shows ground-water storage near end of November and change in ground-water storage from end of October to end of November.

SOUTHEAST

[Alabama, Florida, Georgia, Kentucky, Mississippi, North Carolina, South Carolina, Tennessee, Virginia, and West Virginia]

Streamflow increased seasonally in Alabama, Kentucky, Mississippi, North Carolina, and Tennessee, generally decreased seasonally in Florida, and was variable elsewhere in the region. Monthly mean discharge remained in the above-normal range in all parts of the region for the 3d consecutive month, and was highest of record for November in parts of North Carolina and Tennessee. Mean flows were above the normal range for the 6th consecutive month in parts of Alabama and Kentucky, for the 8th consecutive month in parts of Mississippi and Tennessee, and for the 9th consecutive month in parts of Georgia. Minor flooding occurred in parts of Mississippi and North Carolina.

Ground-water levels declined but were above average in Kentucky, Virginia, and in most of West Virginia. They rose in Alabama and declined in Florida, and were above and below average. Trends were mixed in North Carolina, Mississippi, and Georgia. New month-end high levels occurred in West Virginia and Virginia, and a new alltime high was recorded in Kentucky.

STREAMFLOW CONDITIONS

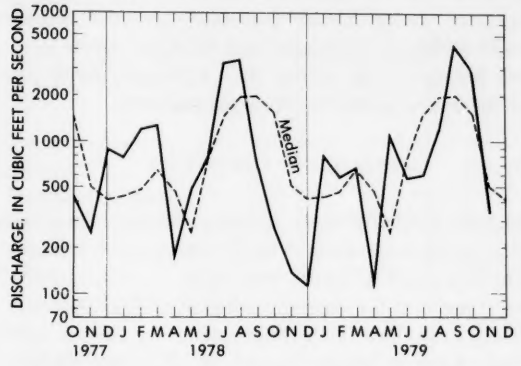
In south-central Mississippi, runoff from rainfall of about 7 inches, reported to have fallen November 22–25 in Pearl River basin upstream from Jackson, resulted in minor flooding along Pearl River flood plain in that city. In the adjacent basin of Big Black River, monthly mean flow near Bovina increased, remained above the normal range, and was 10 times median. In the northeastern part of the State, mean discharge of Tombigbee River at Columbus also increased sharply, remained in the above-normal range for the 8th consecutive month, and was 9 times the November median discharge.

Downstream, in the adjacent area of northwestern Alabama, the monthly mean flow of Tombigbee River at Demopolis lock and dam, near Coatopa, also increased sharply, was 576 percent of median, and was above the normal range for the 8th time in the past 11 months. In extreme northern Alabama, mean discharge of Paint Rock River near Woodville increased seasonally, was about 10 times the median flow for the month, and was above the normal range for the 7th time in the past 8 months. In central Alabama, mean flow of Cahaba River at Centreville also increased seasonally, as a result of runoff from rains early in the month, was 4 times median, and remained in the above-normal range for the 8th time in the past 9 months.

In Georgia, monthly mean flows were variable but remained in the above-normal range throughout the State. For example, in the extreme northern part of the State, mean discharge of Etowah River at Canton increased sharply, as a result of runoff from rains early in the month, and was above the normal range for the 10th time in the past 11 months. In west-central Georgia, monthly mean flow of Flint River near Culloden also increased seasonally and remained in the above-normal range. In the eastern and southern parts of the State, respectively, mean flows of Altamaha River at Doctortown and Alapaha River at Statenville decreased seasonally but remained above the normal range.

In east-central Florida, monthly mean discharge of St. Johns River near Christmas also decreased seasonally and

remained in the above-normal range. Elsewhere in the State, mean flows also decreased seasonally but were within the normal range. For example, in the west-central part of the State, monthly mean discharge of Peace River at Arcadia decreased sharply and was only 66 percent of the November median flow. (See graph.)



Monthly mean discharge of Peace River at Arcadia, Fla. Drainage area, 1,367 sq mi; 3,541 sq km)

In the Inner Coastal Plain of South Carolina, mean flow of North Fork Edisto River at Orangeburg increased seasonally and remained in the above-normal range for the 6th time in the past 7 months. In the northeastern part of the State, monthly mean flow of Lynches River at Effingham increased seasonally and that of Pee Dee River at Peedee decreased seasonally, but both remained above the normal range for the 3d consecutive month, and were 2½ and 3 times their respective November medians.

In the upper reaches of French Broad River basin, in extreme southwestern North Carolina, minor flooding occurred in the vicinity of Rosman as a result of runoff from moderate to heavy rains, reported to have fallen on the 2d and again on the 25th and 26th. Downstream, the monthly mean discharge of 4,870 cfs on French Broad River at Asheville (drainage area, 945 square miles) was highest for November since records began in October 1895, and remained above the normal range for the 10th time in the past 11 months. In the west-central Piedmont, mean flow of South Yadkin River near Mocksville increased seasonally, was 2½ times median, and remained in the above-normal range for the 9th time in the past 11 months. In the eastern Piedmont and Coastal Plain, monthly mean discharges of Cape Fear River at William O. Huske Lock near Tarheel and Neuse River near Clayton increased seasonally, were above the normal range, and were 4 and 5 times their respective median flows for the month.

In Tennessee, monthly mean flows increased and remained in the above-normal range in all parts of the State. For example, in the north-central part of the State, the mean discharge of 2,595 cfs on Harpeth River at Kingston Springs (drainage area, 681 square miles) was highest for November since records began in October 1924, and was above the normal range for the 7th time in the past 8 months. In the eastern and western parts of the State, respectively, mean flows of Emory River at Oakdale and Buffalo River near Lobelville increased sharply and remained above the normal range for the 8th consecutive month.

In northern Kentucky, monthly mean flow of Licking River at Catawba increased sharply, was 10 times median, and remained above the normal range for the 7th time in the past 8 months. In the southern part of the State, mean discharge of Green River at Munfordville also increased sharply and was 10 times median, and remained in the above normal range for the 6th time in the past 8 months. Monthly mean flow of Ohio River at Louisville increased seasonally, was 3½ times median, and remained above the normal range for the 6th consecutive month.

In West Virginia, monthly mean flows generally decreased, but remained above the normal range in all parts of the State. For example, in the southwestern part of the State, mean discharge of Kanawha River at Kanawha Falls increased seasonally, was 330 percent of median, and remained above the normal range for the 8th time in the past 9 months. In eastern West Virginia, mean flow of Greenbrier River at Alderson decreased, but was above the normal range for the 6th time in the past 7 months, and in extreme northern West Virginia, mean discharge of Potomac River at Paw Paw also decreased but remained in the above-normal range for the 7th time in the past 9 months.

In southwestern Virginia, monthly mean flow of North Fork Holston River near Saltville increased sharply, as a result of runoff from rains near monthend, was 6 times median, and remained in the above-normal range for the 5th time in the past 6 months. In the northern part of the State, mean discharge of Rapidan River near Culpeper continued to decrease but remained above the normal range for the 4th consecutive month. In central Virginia, monthly mean flow of Slate River near Arvonia also decreased, contrary to the normal seasonal pattern, and was in the normal range.

GROUND-WATER CONDITIONS

In West Virginia, water levels generally declined except in a few northern counties. Levels were mostly above average. The level in the Glenville water-table well in Gilmer County, despite a decline of less than ½ foot, was at a new month-end high for November in 26 years of record.

In Kentucky, levels generally declined seasonally in most areas, but were above average throughout the State. Levels continued to rise in the downtown Louisville area, and were at or near record highs in several key wells with records that started in the late 1930's and early 1940's. Despite a slight net decline during November, the level in the key water-table well in sand and gravel in the Ohio River valley near Louisville was again at a new alltime high in 34 years of record.

In Virginia, levels declined slightly in the key wells but were several feet above average. Despite the declines, levels were at new November highs for the third consecutive month in the Tyler and Matoaka Manor wells, in 27 and 39 years of record, respectively.

In western Tennessee, the artesian level in the key well in the "500-foot sand" near Memphis held steady, but continued nearly 15 feet below average.

In North Carolina, levels in key observation wells rose in the mountains but declined in the remainder of the State. Levels were above average in the mountains and in the Piedmont but below average in the Coastal Plain.

In Mississippi, levels rose moderately in the Sparta Sand in the Jackson area, following record lows that were established during the year. Most wells in the Mississippi River alluvium rose, while a few continued to decline slightly. Levels in the Miocene aquifers and in the Graham Ferry Formation in Southern Mississippi continued to decline slightly, while levels in the Citronelle Formation rose. In Northern Mississippi, levels in the Wilcox and Upper Cretaceous aquifers held fairly steady except in a few areas influenced by heavy withdrawals.

Levels in Alabama rose, and were above and below average.

In Georgia, levels in the Piedmont rose as much as 2 feet. In the coastal counties, levels in the principal artesian aquifer also rose as much as 2 feet near Savannah and were about ½-foot lower near Brunswick. Levels in the water-table aquifer in these areas were near average. In the southeast, levels rose as much as 6 feet.

In Florida, levels generally declined statewide. In northwestern Florida near Pensacola and Tallahassee levels were 1½ to more than 2 feet above average, and were 6 feet below average in the northeast near Jacksonville. In north-central peninsular Florida, near Ocala, levels were $^1/_3$ foot below average, and were 1½ feet below average at Tampa, on the west coast, and $3^1/_3$ foot below average near Mulberry in west-central Polk County. In southern Florida, levels ranged from about average in Dade County to nearly ½ foot above average in Palm Beach and St. Lucie Counties.

WESTERN GREAT LAKES REGION

[Ontario; Illinois, Indiana, Michigan, Minnesota, Ohio, and Wisconsin]

Streamflow increased in Illinois, Indiana, Minnesota, and Wisconsin, and was variable in Michigan, Ohio, and Ontario. Monthly mean flows remained in the above-normal range in parts of Indiana, Michigan, Minnesota, Ohio, Ontario, and Wisconsin. Monthly or daily mean discharges were highest of record for the month in parts of Indiana, Michigan, and Minnesota. Flooding occurred in Indiana.

Ground-water levels rose in Indiana and declined in Wisconsin; mixed trends prevailed in other States. Except locally in Wisconsin and Michigan, levels were above average in the region. New high-water levels for November were reached in Michigan and Ohio.

STREAMFLOW CONDITIONS

In southwestern Indiana, flooding occurred late in the month in the lower parts of the Wabash and White River basins as a result of runoff from rains, reported to have been as much as 5 inches at some points. Monthly mean discharges of East Fork White River at Shoals and Wabash River at Mount Carmel, Ill., increased sharply and remained in the above-normal range for the 5th consecutive month. The daily mean discharge of 29,000 cfs at Shoals on the 29th was the highest for November in 66 years of record. In northeastern Indiana, monthly mean discharge of Mississinewa River at Marion also increased sharply, was about 6½ times median, and was above the normal range.

In central Ohio, where monthly mean discharge of Scioto River at Higby was highest of record for September and October, mean flow increased seasonally, was 7 times the November median, and remained above the normal range for the 4th consecutive month, but was about one-half the maximum November mean of record. In the northeastern part of the State, mean flow of Little Beaver Creek near East Liverpool decreased, contrary to the normal seasonal pattern, but remained in the above-normal range for the 3d consecutive month. In northwestern Ohio, where mean discharge of Maumee River at Waterville was only 70 percent of median in October, monthly mean flow increased sharply to 2½ times the November median and was above the normal range for the 4th time in the past 5 months.

In Michigan's Upper Peninsula, monthly mean flow of Sturgeon River near Sidnaw decreased but remained in the above-normal range, and the daily mean discharge of 1,030 cfs on the 1st (carryover from October) was highest for November in 40 years of record. The monthly mean elevation of Lake Michigamme was about 0.8 foot higher than the 25-year median elevation for the month. In the Lower Peninsula, mean flows of Red Cedar River at East Lansing and Muskegon River at Evart decreased, contrary to the normal seasonal pattern, were less than their respective November

(Continued on page 8.)

SELECTED DATA FOR THE GREAT LAKES, GREAT SALT LAKE, AND OTHER HYDROLOGIC SITES

GREAT LAKES LEVELS

Water levels are expressed as elevations in feet above International Great Lakes Datum 1955

(Data furnished by National Ocean Survey, NOAA, via U.S. Army Corps of Engineers office in Detroit. To convert data to elevations above mean sea level datum of 1929, add the following values: Superior, 0.96; Michigan-Huron, 1.20; St. Clair, 1.24; Erie, 1.57; Ontario, 1.22.)

Lake	November 30, 1979	Monthly mean, November		November		
		1979	1978	Average 1900–75	Maximum (year)	Minimum (year)
Superior (Marquette, Mich.)	601.28	601.14	600.68	600.82	601.81 (1974)	599.17 (1925)
Michigan and Huron (Harbor Beach, Mich.)	579.57	579.44	578.72	578.05	580.20 (1973)	575.57 (1964)
St. Clair (St. Clair Shores, Mich.)	574.36	574.50	573.89	572.92	575.18 (1972)	570.83 (1934)
Erie (Cleveland, Ohio)	571.20	571.41	570.74	569.84	572.17 (1972)	567.60 (1934)
Ontario (Oswego, N.Y.)	244.27	244.23	243.70	244.06	246.18 (1945)	241.45 (1934)

GREAT SALT LAKE

Alltime high: 4,211.6 (1873). Alltime low: 4,191.35 (October 1963).	November 30, 1979	November 30, 1978	Reference period 1904–78		
			November average, 1904–78	November maximum (year)	November minimum (year)
Elevation in feet above mean sea level:	4,197.60	4,198.50	4,197.70	4,204.10 (1923)	4,191.70 (1963)

LAKE CHAMPLAIN, AT ROUSES POINT, N.Y.

Alltime high (1827–1977): 102.1 (1869). Alltime low (1939–1977): 92.17 (1941).	November 29, 1979	November 30, 1978	Reference period 1939–78		
			November average, 1939–78	November max. daily (year)	November min. daily (year)
Elevation in feet above mean sea level:	95.99	93.99	94.86	98.52 (1977)	93.12 (1953)

FLORIDA

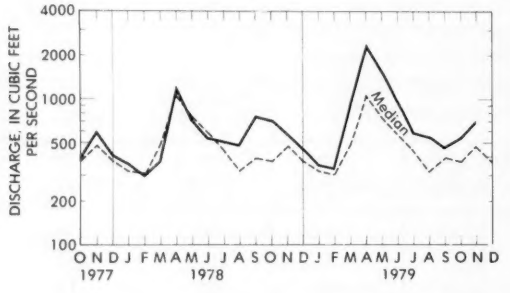
Site	November 1979		October 1979	November 1978
	Discharge in cfs	Percent of normal	Discharge in cfs	Discharge in cfs
Silver Springs near Ocala (northern Florida)	955	97	950	770
Miami Canal at Miami (southeastern Florida)	220	79	211	367
Tamiami Canal outlets, 40-mile bend to Monroe	334	196	636	117

(Continued from page 6.)
median flows, but were within the normal range. Monthly mean levels of Houghton Lake and Crooked Lake were above normal for the month, but that of Lake Mitchell-Cadillac was below normal.

In eastern Ontario, monthly mean flow of Missinaibi River at Mattice decreased, but remained in the above-normal range and was 206 percent of median as a result of high carryover flow from October. Elsewhere in the Province, mean flows increased and were greater than November median discharges but were in the normal range.

In extreme northern Minnesota, in Lake of the Woods basin, where October monthly mean flow of Rainy River at Manitou Rapids was only 44 percent of median and was in the below-normal range, mean discharge increased sharply, contrary to the normal seasonal pattern, was greater than the November median and was in the normal range. In the west-central part of the State, mean flow of Buffalo River near Dilworth also increased, contrary to the normal seasonal pattern, and was above the normal range. In southwestern Minnesota, mean discharge of Minnesota River near Jordan also increased, as a result of runoff from rains early in the month, in contrast to the normal seasonal pattern of decreasing flow, was 8 times the November median and remained in the above-normal range for the 5th consecutive month. Similarly, in the adjacent basin of Des Moines River, in extreme southern Minnesota, the monthly mean discharge of 1,700 cfs in Des Moines River at Jackson (drainage area, 1,220 square miles) was highest for November since records began in 1936, as a result of runoff from the early November rains. In the central part of the State, monthly mean flow of Crow River at Rockford increased sharply, also as a result of runoff from rains near the beginning of the month, was 6½ times the November median flow and was in the above-normal range.

In north-central Wisconsin, mean flow of Oconto River near Gillett increased seasonally, as a result of high carryover flow from October, augmented by increased runoff from rains near monthend, and was above the normal range for the 8th time in the past 9 months. (See graph.) Elsewhere in the State, monthly mean discharges also increased seasonally, were greater than median for the month, but were in the normal range.



Monthly mean discharge of Oconto River near Gillett, Wis. (Drainage area, 678 sq mi; 1,756 sq km)

In Illinois, monthly mean discharges increased seasonally in all parts of the State and were within the normal range. Mean flows of Pecatonica River at Freeport and Rock River near Joslin, in northern Illinois, and Skillet Fork at Wayne City, in the southern part of the State, were greater than median, while monthly mean flow of Sangamon River at Monticello, in central Illinois, was only 37 percent of the November median discharge.

GROUND-WATER CONDITIONS

Levels in shallow water-table wells in Minnesota declined but continued above average. In the Minneapolis-St. Paul area, artesian levels rose or held fairly steady in wells tapping the Prairie du Chien-Jordan and the deeper Mt. Simon-Hinckley aquifers, and continued above average.

In Wisconsin, levels generally declined but continued near normal in most of the State, except in the deep sandstone aquifer in southeastern Wisconsin, where levels continued to decline and were below average.

In Michigan, levels rose and continued above average in the Upper Peninsula; the level in the water-table observation well in glacial drift at Ishpeming reached a new high for November in 18 years of record. Levels in wells in most areas of the Lower Peninsula generally declined and continued below average.

In Illinois, the level in the shallow well in glacial drift at Princeton, Bureau County, declined slightly but continued above average by 2½ feet.

In Indiana, levels generally rose and were well above average statewide.

Levels declined in northeastern Ohio but continued above average. In central Ohio, levels rose; the level in the Franklin County key well in shallow gravel rose, was above average, and reached a new high for November in 33 years of record.

MIDCONTINENT

[Manitoba and Saskatchewan; Arkansas, Iowa, Kansas, Louisiana, Missouri, Nebraska, North Dakota, Oklahoma, South Dakota, and Texas]

Streamflow decreased in Manitoba and Saskatchewan but increased in all other parts of the region. Monthly mean flows remained in the above-normal range in parts of Iowa, Louisiana, North Dakota, South Dakota, and Texas, and increased into that range in parts of Arkansas, Kansas, and Nebraska. Mean flows remained in the below-normal range in parts of Nebraska and

decreased into that range in parts of Saskatchewan. Monthly and daily mean discharges were highest of record for the month in parts of Iowa and South Dakota, and daily mean discharge was highest for the month in part of Nebraska. Flooding occurred in Kansas, Missouri, Louisiana, and Oklahoma.

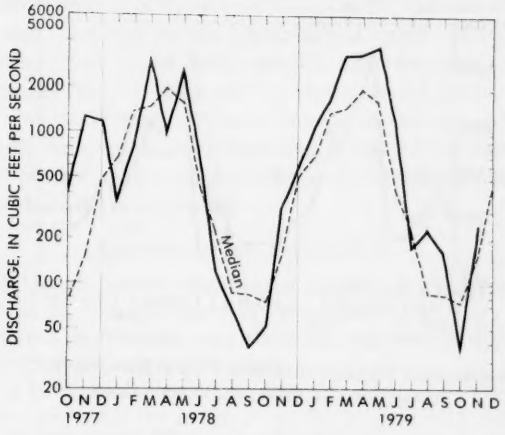
Ground-water levels rose in the region except for local declines in North Dakota, Iowa and Texas. Levels were below average in Kansas and Arkansas, and mixed with respect to average elsewhere. New November low levels were recorded in Arkansas and Texas; a new alltime low also was reached in Texas.

STREAMFLOW CONDITIONS

In the Pearl River basin, in southeastern Louisiana and the adjacent area of southern Mississippi, monthly mean discharge of Pearl River near Bogalusa, La. decreased slightly but remained in the above-normal range for the 11th consecutive month, as a result of high carryover flow from October and increased runoff from rains November 22–25. Minor flooding was reported to have occurred along the lower reaches of Pearl River November 26–30. Also in the Amite River basin, in southeastern Louisiana and the adjacent area of southeastern Mississippi, monthly mean flow of Amite River near Denham Springs increased sharply as a result of runoff from rains late in the month, was 2½ times median, and was above the normal range. In the south-central part of the State, monthly mean discharge of Calcasieu River near Oberlin increased sharply, was 7½ times the November median, and was in the above-normal range for the 5th consecutive month.

In southern Arkansas, monthly mean flow of Saline River near Rye also increased sharply as a result of runoff from rains near monthend, was 4 times the November median discharge, and was above the normal range for the 11th time in the past 13 months. In northern Arkansas, where mean discharge of Buffalo River near St. Joe was below the normal range and only 45 percent of median in October, mean flow increased sharply as a result of runoff from rains November 21–23, was 184 percent of median, and was in the normal range. (See graph.)

In north-central Oklahoma, rapid runoff from intense rains on the 20th resulted in minor flooding along several small streams in and near Ponca City. In the southwestern part of the State, where monthly mean flow of Washita River near Durwood was in the below-normal range and only 29 percent of median in October, mean flow increased sharply as a result of runoff from the rains of November 19–20, was in the normal range and was 106 percent of the median discharge for the month.

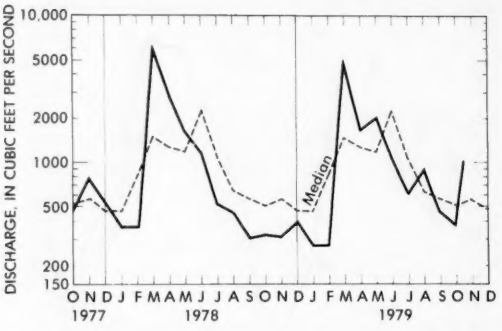


Monthly mean discharge of Buffalo River near St. Joe, Ark.
(Drainage area, 829 sq mi; 2,147 sq km)

In south-central Missouri, monthly mean discharge of Gasconade River at Jerome increased sharply, as a result of runoff from rains near midmonth, and was 213 percent of median but remained in the normal range. In the northwestern part of the State, where mean flow of Grand River near Gallatin was only 10 percent of median in October, monthly mean discharge increased sharply, as a result of runoff from rains November 21–22, and was 125 percent of the November median flow. In west-central Missouri, minor flooding was reported along Osage River near monthend.

In southwestern Iowa, monthly mean flow of Nishnabotna River above Hamburg increased sharply, contrary to the normal seasonal pattern of decreasing flow, was 3 times the November median and was above the normal range. Similarly, in north-central Iowa, monthly mean discharge of Des Moines River at Fort Dodge (drainage area, 4,190 square miles) increased sharply, contrary to the normal seasonal pattern, and was 21 times the median flow for the month. The monthly mean flow of 4,110 cfs was highest for the month in 48 years of record and remained in the above-normal range for the 5th consecutive month. In eastern Iowa, mean flow of Cedar River at Cedar Rapids also increased sharply, was above the normal range for the 7th time in the past 9 months, and was 420 percent of median.

In northeastern Nebraska, monthly mean discharge of Elkhorn River at Waterloo (drainage area, 6,900 square miles) increased sharply, as a result of carryover runoff from rains that fell at the end of October and other rains late in November. The daily mean discharge of 3,100 cfs on November 1 was highest for the month in 60 years of record, and the monthly mean of 1,002 cfs was in the above-normal range. (See graph on page 10.) In the



Monthly mean discharge of Elkhorn River at Waterloo, Nebr.
(Drainage area, 6,900 sq mi; 17,900 sq km)

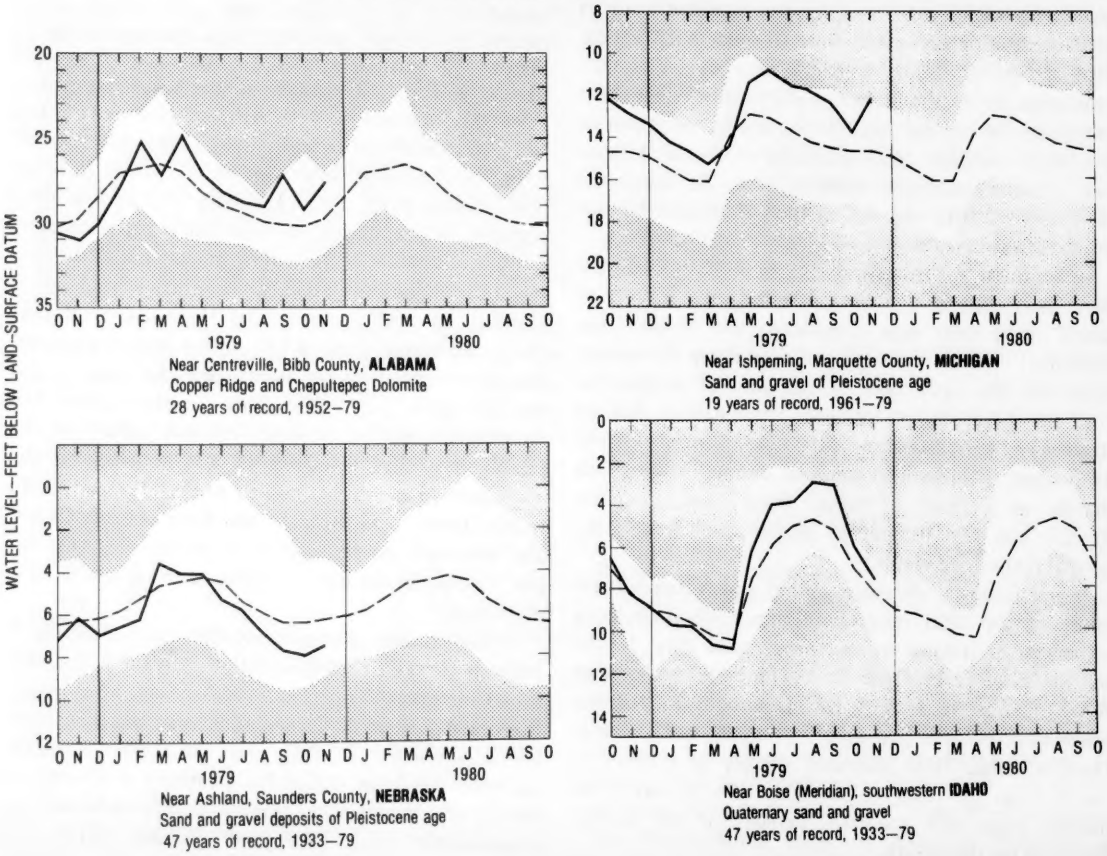
northwestern part of the State, monthly mean flow of Niobrara River above Box Butte Reservoir increased seasonally, but at less than the normal seasonal rate, and was in the below-normal range. Unregulated flows of streams in the Republican River basin, in southwestern Nebraska, were reported to be between about 50 percent and 90 percent of median for the month. Flow in North Platte River, in the western part of the State, was reported to be normal during the month.

In the Big Sioux River basin, in eastern South Dakota and the adjacent areas of Minnesota and Iowa, mean flow of Big Sioux River at Akron, Iowa (drainage area, 9,030 square miles) increased sharply as a result of rapid runoff from intense rains early in the month. The monthly mean discharge of 2,980 cfs, and the daily mean discharge of 8,290 cfs on the 4th, were highest for November since records began in October 1928. In the central part of the State, no flow was observed in Bad River near Fort Pierre during the entire month.

In eastern North Dakota, monthly mean flow of Red River of the North at Grand Forks increased, as a result of inflow of water released from storage in lakes in Minnesota, and was above the normal range. In the

MONTH-END GROUND-WATER LEVELS IN KEY WELLS

UNSHADED AREA INDICATES RANGE BETWEEN HIGHEST AND LOWEST RECORD FOR THE MONTH
DOTTED LINE INDICATES AVERAGE OF MONTHLY LEVELS, IN PREVIOUS YEARS
HEAVY LINE INDICATES LEVEL FOR CURRENT PERIOD



southwestern part of the State, monthly mean flow of Cannonball River at Breien increased seasonally and remained in the above-normal range for the 7th time in the past 8 months, as a result of a continued high rate of ground-water inflow and increased runoff from precipitation late in the month.

In southeastern Saskatchewan, monthly mean flow of Qu'Appelle River near Lumsden decreased, in contrast to the normal seasonal pattern of increasing flow, and was below the normal range.

In southern Manitoba, mean discharge of Waterhen River below Waterhen Lake continued to decrease seasonally and remained in the normal range. The level of Lake Winnipeg at Gimli averaged 713.98 feet above mean sea level for the month, 0.31 foot lower than last month, 0.21 foot lower than last November, 0.59 foot higher than the long-term mean for November, 2.50 feet lower than the maximum average level for November (occurred in 1948), and 3.79 feet higher than the minimum average level for the month (occurred in 1940). Records of Lake Winnipeg levels were started in May 1913 at Winnipeg Beach.

In eastern Texas, monthly mean discharge of Neches River near Rockland increased seasonally and remained in the above-normal range for the 7th time in the past 9 months. In the west-central part of the State, no flow has been observed in North Concho River near Carlsbad since August 15. Runoff was reported to be in the normal range in the southeastern half of the State, with the exception of the lower parts of the Sabine, Angelina, and Neches River basins, where monthly mean flows were above the normal range. Elsewhere in the State, runoff was reported to be below the normal range. Records from 38 reservoirs in the State show that storage decreased in 30 and increased in 8.

In extreme southeastern Kansas, severe flash flooding was reported November 21 along Marmaton, Neosho, and Verdigris Rivers as a result of rapid runoff from rainfall amounts of 6 inches to more than 9 inches, as observed by the National Weather Service. In northwestern Kansas, where monthly mean discharges in Saline River near Russell were below the normal range and only 5 percent and 11 percent of the respective median flows in September and October, mean flow increased in November, contrary to the normal seasonal pattern, was 53 percent of median, and was within the normal range. In the Little Blue River basin in the north-central part of Kansas and the adjacent area of Nebraska, where monthly mean flows of Little Blue River at Barnes, Kans. were below the normal range and only 30 percent and 42 percent of the respective median flows in September and October, monthly mean discharge increased sharply, in contrast to the normal seasonal pattern of decreasing flow, was 295 percent of median, and was in the above-normal range. In the southern part of the State, monthly mean discharge of Arkansas River at Arkansas City also increased sharply, as a result of high carryover flow from October and runoff from rains at the beginning of the month, was 810 percent of the median discharge for November, and was above the normal range.

GROUND-WATER CONDITIONS

In North Dakota, water levels declined in the west, rose in the east, and were near average statewide.

Levels in Nebraska rose statewide and were near or slightly above long-term averages.

In Iowa, levels in shallow wells rose slightly and were above average in the northern two-thirds of the State but declined and were below average in the south.

In Kansas, the level in the Agricultural Experiment Station observation well in Thomas County rose slightly but continued 6 feet below average. Levels rose but continued below average in the key wells in Sedgwick and Harvey Counties.

In east-central Arkansas, the level in the key well in the shallow Quaternary aquifer rose slightly but continued more than 6 feet below average. The level in the Heien well in the deep Sparta Sand at Stuttgart rose 9 feet but continued nearly 14 feet below average. In the industrial aquifer of central and south Arkansas, the level in the key well at Pine Bluff rose more than 2 feet but nevertheless was at a new November low in 21 years of record.

In Louisiana, the artesian level in the key well in Iowa, La., in the southwestern rice-growing area, continued to recover——by more than 3 feet——but was more than 14 feet below average. The level in the well in Pleistocene sand and gravel in central Louisiana rose slightly and continued nearly a foot above average.

In Texas, levels in key wells in the Edwards aquifer declined at Austin and rose at San Antonio; levels were above average. Levels rose but were below average in the Evangeline aquifer at Houston and in the bolson deposits at El Paso. A new November low level was recorded in the key well at El Paso, in 21 years of record, despite the net rise during the month. A new alltime low was recorded in the well in the Ogallala aquifer at Plainview in the Texas Panhandle.

WEST

[Alberta and British Columbia; Arizona, California, Colorado, Idaho, Montana, Nevada, New Mexico, Oregon, Utah, Washington, and Wyoming]

Streamflow generally increased seasonally in Arizona, California, Nevada, and Oregon, decreased seasonally in Alberta and British Columbia, and was variable in all other parts of the region. Monthly mean flows remained

below the normal range in parts of Alberta, British Columbia, Colorado, Idaho, Montana, New Mexico, Utah, and Washington, and decreased into that range in parts of Arizona and Oregon. Mean flows remained in the above-normal range in parts of California and increased into that range in parts of Colorado, New Mexico, and Wyoming. Mean flows were below the normal range for the 4th consecutive month in parts of Alberta and British Columbia, and for the 6th consecutive month in parts of Idaho, Montana, and Washington.

Ground-water levels rose in Utah and Arizona, and declined in Montana; mixed trends prevailed elsewhere in the region. In Montana and Arizona, levels were below average; they were mostly below average in Idaho, Utah, and New Mexico. Levels were mixed with respect to average elsewhere. A new high level was reached in Utah, and new low levels were recorded in Idaho, Nevada, Utah, Arizona, and New Mexico. A new alltime low occurred in Arizona.

STREAMFLOW CONDITIONS

In Alberta, streamflow decreased seasonally and was below the normal range for the 4th consecutive month at Athabasca River at Hinton (drainage area, 4,000 square miles) and the monthly mean flow of 1,300 cfs was only 65 percent of median. Also, mean flow of Bow River at Banff continued to decrease seasonally and was below the normal range for the 8th time in the past 9 months.

In northern British Columbia, monthly mean flow of Skeena River at Usk decreased sharply to only 45 percent of median and was below the normal range for the first time since January 1979. In the southern part of the Province, mean flow of Fraser River at Hope decreased to 55 percent of median and remained in the below-normal range for the 4th consecutive month.

Similarly, in northwestern Washington, monthly mean flow of Skykomish River near Gold Bar decreased to ¼ the November median flow and was below the normal range for the 4th consecutive month. In the eastern part of the State, mean flow of Spokane River at Spokane increased seasonally but was only 41 percent of median and remained in the below-normal range for the 6th consecutive month. In the southeastern part of the State, monthly mean discharge of Chehalis River near Grand Mound was only 32 percent of median and below the normal range for the first time since June 1979. The low streamflow throughout the State was causing increasing concern, especially to those who generate electricity from hydropower.

In Idaho, streamflow at all index stations continued in the below-normal range. For the Salmon River at White Bird and Snake River near Heise, this was the 6th consecutive month of flows in the below-normal range. In the northern part of the State, the seasonal increase in mean flow of Clearwater River at Spalding was less than normal, was only 41 percent of median, and remained in the below-normal range for the 5th consecutive month. Storage for power in northern Idaho decreased. Reservoir storage for irrigation in southern Idaho increased but remained below average.

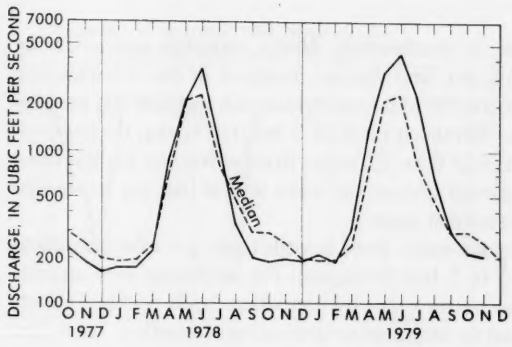
West of the Continental Divide in northwestern Montana, mean flow in Clark Fork at St. Regis decreased, contrary to the normal seasonal pattern of increasing flows, and remained in the below-normal range for the 6th consecutive month. Also in northwestern Montana, mean flow of Middle Fork Flathead River near West Glacier decreased to only 35 percent of median, remained in the below-normal range, and was lowest for November since 1953. East of the Continental Divide, monthly mean flows of Marias River near Shelby and Yellowstone River at Corwin Springs persisted in the below-normal range for the 5th consecutive month. At index stations on the Yellowstone River located at Corwin Springs and at Billings, mean flows were lowest for November since 1961.

In northern Wyoming, monthly mean discharge in Tongue River near Dayton decreased seasonally and remained below median for the 9th consecutive month but was within the normal range. In the southern part of the State, mean flow of North Platte River above Seminoe Reservoir, near Sinclair increased seasonally and was above the normal range.

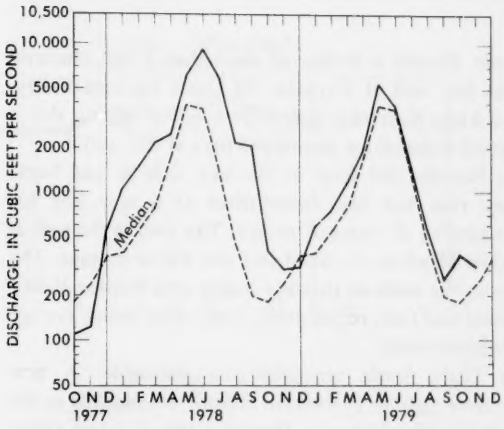
In central Colorado, where monthly mean flow at the index station, Roaring Fork River at Glenwood Springs, was below the normal range and only 87 percent of median in October, streamflow during November increased sharply to 121 percent of median and was above the normal range. In the northwestern part of the State, monthly mean discharge of Yampa River at Steamboat Springs increased slightly but was in the below-normal range following 8 consecutive months of flow in the normal range. In the southwestern part of the State, mean flow of Animas River at Durango decreased seasonally and remained in the below-normal range. (See graph on page 13.)

In northern New Mexico and the adjacent area of southern Colorado, monthly mean discharge of Rio Grande below Taos Junction Bridge, near Taos, N. Mex. increased seasonally but remained in the below-normal range for the 2d consecutive month. In the southeastern part of the State, mean flow of Delaware River near Red Bluff increased to 258 percent of median and was in the above-normal range. Elsewhere in the State, mean flows at index stations were within the normal range.

In southern Arizona, monthly mean flow of San Pedro River at Charleston increased seasonally but was



Monthly mean discharge of Animas River at Durango, Colo. (Drainage area, 692 sq mi; 1,792 sq km)



Monthly mean discharge of Kings River above North Fork, near Trimmer, Calif. (Drainage area, 952 sq mi; 2,466 sq km)

below the normal range as a result of low carryover flow from October. Elsewhere in the State, mean flows generally increased and were within the normal range at all index stations.

In northwestern Utah, mean flow in Big Cottonwood Creek near Salt Lake City continued to decrease seasonally and was below the normal range for the first time since June 1979. In the northeastern part of the State, monthly mean flows of Weber River near Oakley and Whiterocks River near Whiterocks were about 80 percent of median and remained in the below-normal range for the 3d consecutive month. In the extreme southeastern part of the State, flow in San Juan River near Bluff increased to 77 percent of median but remained in the below-normal range for the 4th consecutive month. Elsewhere in the State, mean flows were generally below median at index stations but were within the normal range.

In north-central Nevada, where monthly mean flow of Humboldt River at Palisade was above the normal range and 166 percent of median in October, mean flow increased seasonally and was in the normal range in November.

Contents of the Colorado River Storage Project decreased 439,200 acre-feet during the month.

In north-coastal California, monthly mean discharge of Smith River near Crescent City increased sharply to 152 percent of the November median flow and remained in the above-normal range for the 2d consecutive month. In the southern Sierra Nevada west slope, mean flow of Kings River above North Fork, near Trimmer, decreased contrary to the normal seasonal pattern of increasing flow, and was within the normal range and 131 percent of median. (See graph.) Elsewhere in the State, streamflow increased seasonally and was within the normal range. Combined contents of 10 reservoirs in northern California were 108 percent of average and 93 percent of the contents one year ago.

In Oregon, streamflow increased seasonally throughout the State and was within the normal range except in the north-coastal basin of Wilson River where monthly mean flow as measured near Tillamook increased but was only 37 percent of median and below the normal range.

GROUND-WATER CONDITIONS

In Washington, the water level rose slightly in the key well in Tacoma and was 2.7 feet above average. The level in the Spokane Valley observation well declined slightly and was slightly below average.

The level in the well penetrating the sand and gravel aquifer in the Boise Valley continued its seasonal decline and was slightly above average. Levels in the key wells representative of the Snake River Plain aquifer reached new November lows in the eastern, south-central, and southwestern parts, despite mixed trends. The level declined and was below average in the western part near Gooding. The level in the well representative of the alluvial aquifer underlying the Rathdrum Prairie, northern Idaho, declined and was below average.

In Montana, the levels in the water-table well in alluvium at Hamilton Fairgrounds, and in the shallow well in terrace gravel at Missoula, declined more than 2 feet and more than 1 foot, respectively, and continued slightly below average.

In southern California, the level in the key well in Los Angeles County in the San Gabriel basin continued to decline and remained below average. In Orange County, in the Los Alamitos area, the level in the key well continued to rise, but remained below average. In Santa Barbara County, the level in the key well in Santa Ynez Valley continued to rise, and the level in the key well in Santa Maria Valley declined; both continued above

average. Despite a decline of more than 2 feet, the level in the key well at Cuyama, the Upper Cuyama Valley, was at a new November high in 29 years of record; this is the sixth consecutive month-end high at this well.

In Nevada, the level in the key well in Las Vegas Valley rose but was nevertheless at a new low for November in 33 years of record. The level in the well at Truckee Meadows declined and was below average. The levels in the wells at Paradise Valley and Steptoe Valley declined and rose, respectively; levels were above average in both key wells.

In Utah, levels generally rose statewide. A new November high, in 19 years of record, was reached in the well in the Blanding area. Despite a rise of 2 feet in the well in the Holladay area, the level was at a new low for November in 31 years of record. Levels were generally below average except in the Blanding area, where they have continued above average since July 1978.

In Arizona, levels declined in two index wells and rose in three. The level in the well in the Elfrida area rose slightly but was at a new November low in 29 years of record. A new alltime low was recorded in another well.

In New Mexico, trends were mixed, and levels were below average except in the Berrendo-Smith well in the Roswell artesian basin, where the level was nearly 6 feet above average. A new November low was recorded in the Dayton water-table well, in the southern part of the Roswell basin, in 42 years of record.

ALASKA

Streamflow decreased seasonally throughout the State but remained in the above-normal range in southern Alaska and increased into that range in parts of the interior. The above-normal streamflows were the result of above-normal temperatures and runoff from excessive precipitation. In the south-central part of the State, the monthly mean discharge of 130 cfs and the daily mean of 320 cfs on the 11th, at Little Susitna River near Palmer (drainage area, 61.9 square miles), were highest for the month in 32 years of record. In the south-coastal basin of Kenai River at Cooper Landing, where monthly mean discharge was highest of record for October, flow decreased seasonally but remained in the above-normal range. In southeastern Alaska, monthly mean flow in Gold Creek near Juneau remained in the above-normal range for the 2d consecutive month and was 206 percent of the November median. In interior Alaska, the seasonal decrease in flow of Tanana River at Nenana was less than the normal amount and mean flow at that site was in the above-normal range.

Ground-water levels in wells tapping confined aquifers rose 1 to 3 feet throughout the Anchorage area, except in the northeastern section where levels declined about ½ foot in response to decreasing streamflow from the Chugach Mountains. The shallow water table rose slightly in November.

HAWAII

Severe flooding occurred in the northeastern part of the island of Hawaii November 18 as a result of rapid runoff from torrential rains of more than 15 inches, reported to have fallen during the period November 15–18. Property and crop damage was estimated at 5 million dollars. At the streamflow station, Waiakea Stream near Mountain View, where monthly mean flows had been below the normal range in August, September, and October, mean discharge increased sharply, was 171 percent of the November median flow, and was in the upper portion of the normal range. On the island of Maui, where monthly mean flow of Honopou Stream near Huelo had been in the below-normal range in September and October, monthly mean discharge also increased sharply and was in the above-normal range. On the islands of Oahu and Kauai, where mean discharges at the index stations were below the normal range for four consecutive months, July through October, monthly mean flows also increased sharply, and were in the normal range, but were less than their respective median discharges for the month.

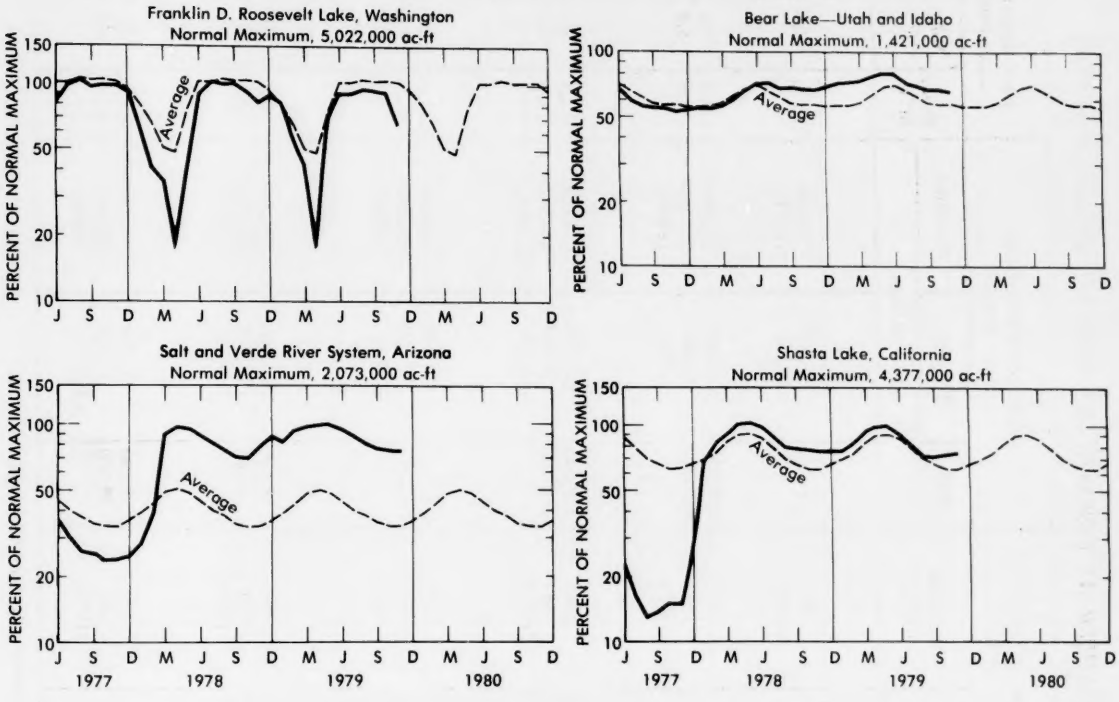
On Guam, Mariana Islands, where monthly mean discharge of Ylig River near Yona was above the normal range in October as a result of runoff from intense rains associated with tropical storm "Tip", mean flow decreased seasonally, remained above median, and was in the normal range.

METRIC EQUIVALENTS OF UNITS USED IN THE WATER RESOURCES REVIEW

(Round-number conversions, to nearest four significant figures)

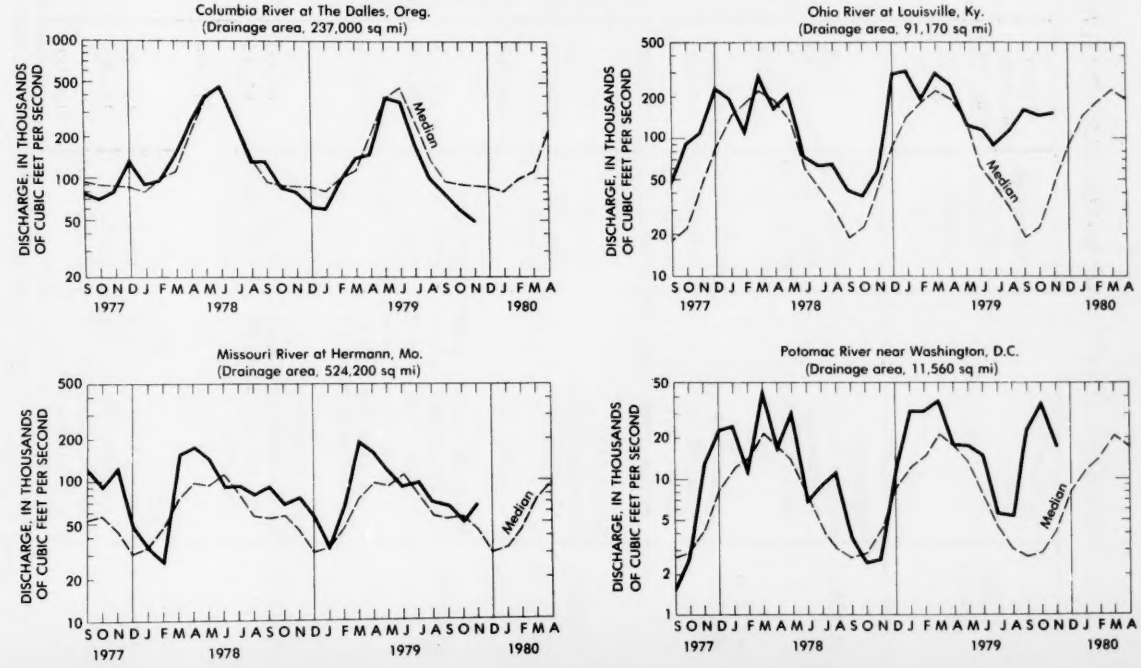
1 foot = 0.3048 meter 1 mile = 1.609 kilometers
1 acre = 0.4047 hectare = 4,047 square meters
1 square mile (sq mi) = 259 hectares = 2.59 square kilometers (sq km)
1 acre-foot (ac-ft) = 1,233 cubic meters
1 million cubic feet (mcf) = 28,320 cubic meters
1 cubic foot per second (cfs) = 0.02832 cubic meters per second = 1.699 cubic meters per minute
1 second-foot-day (cfsd) = 2,447 cubic meters
1 million gallons (mg) = 3,785 cubic meters = 3.785 million liters
1 million gallons per day (mgd) = 694.4 gallons per minute (gpm) = 2.629 cubic meters per minute = 3,785 cubic meters per day

USABLE CONTENTS OF SELECTED RESERVOIRS AND RESERVOIR SYSTEMS, JUNE 1977 TO NOVEMBER 1979



Near or above-average contents characterized many reservoirs in the West during November. Monthend contents of Franklin D. Roosevelt Lake in northwestern Washington, however, declined sharply and was much below average.

HYDROGRAPHS OF FOUR LARGE RIVERS



DISSOLVED SOLIDS AND WATER TEMPERATURES FOR NOVEMBER AT DOWNSTREAM SITES ON SIX LARGE RIVERS

Station number	Station name	November data of following calendar years	Stream discharge during month	Dissolved-solids concentration during month[a]		Dissolved-solids discharge during month[a]			Water temperature during month[b]		
			Mean (cfs)	Minimum (mg/L)	Maximum (mg/L)	Mean	Minimum	Maximum	Mean, in °C	Minimum, in °C	Maximum, in °C
						(tons per day)					
	NORTHEAST										
01463500	Delaware River at	*1979	14,300	.....	.....	.....	.....	.....	.....	.....	.....
	Trenton, N.J.	1944–78	10,310	55	151	.....	469	12,300	.....	2.0	19.0
	(Morrisville, Pa.)	(Extreme yr)		(1955)	(1964)		(1963)	(1972)			
			[c]9,024								
04264331	St. Lawrence River at	1979	288,000	165	167	129,000	125,000	132,000	9.5	7.0	11.5
	Cornwall, Ontario, near	1975–78	282,400	166	169	127,000	106,000	137,000	8.5	5.0	12.0
	Massena, N.Y.	(Extreme yr)		(1976)	(1977)		(1978)	(1977)			
	median streamflow at Ogdensburg, N.Y.		[c]228,000								
	SOUTHEAST										
07289000	Mississippi River at	1979	533,900	233	238	339,000	239,000	418,000	13.0	9.0	20.0
	Vicksburg, Miss.	1975–78	408,300	188	261	246,000	123,000	439,000	14.0	8.0	18.5
		(Extreme yr)		(1977)	(1977)		(1976)	(1977)			
			[c]291,300								
	WESTERN GREAT LAKES REGION										
03612500	Ohio River at lock and dam	**1979	386,000	171	217	.....	74,000	400,000	.....	11.5	16.5
	53, near Grand Chain, Ill.	1954–78	164,400	129	425	.....	27,200	406,000	.....	1.0	19.5
	(25 miles west of Paducah,	(Extreme yr)		(1957)	(1968)		(1954)	(1957)			
	Ky.; streamflow station		[c]120,800								
	at Metropolis, Ill.)										
	MIDCONTINENT										
06934500	Missouri River at Hermann,	1979	66,200	360	483	78,300	65,000	111,000	9.5	7.0	15.0
	Mo. (60 miles west of St.	1975–78	82,280	225	465	82,800	43,600	156,000	9.5	4.5	15.0
	Louis, Mo.)	(Extreme yr)		(1977)	(1975)		(1976)	(1977)			
			[c]43,700								
	WEST										
14128910	Columbia River at	1979	132,100	97	113	37,100	29,600	44,000	11.5	7.5	14.0
	Warrendale, Oreg.	1975–78	128,200	85	128	39,200	23,400	66,400	11.5	6.0	14.5
	(streamflow station	(Extreme yr)		(1976)	(1978)		(1977)	(1978)			
	at The Dalles, Oreg.)		[c]106,500								

[a]Dissolved-solids concentrations when not analyzed directly, are calculated on basis of measurements of specific conductance.
[b]To convert °C to °F: [(1.8 X °C) + 32] = °F.
[c]Median of monthly values for 30-year reference period, water years 1941–70, for comparison with data for current month.
*Dissolved-solids and water-temperature records not available.

USABLE CONTENTS OF SELECTED RESERVOIRS NEAR END OF NOVEMBER 1979

[Contents are expressed in percent of reservoir capacity. The usable storage capacity of each reservoir is shown in the column headed "Normal maximum."]

Reservoir Principal uses: F–Flood control I–Irrigation M–Municipal P–Power R–Recreation W–Industrial	End of Oct. 1979	End of Nov. 1979	End of Nov. 1978	Average for end of Nov.	Normal maximum
	Percent of normal maximum				
NORTHEAST REGION					
NOVA SCOTIA					
Rossignol, Mulgrave, Falls Lake, St. Margaret's Bay, Black, and Ponhook Reservoirs (P)	57	67	27	39	226,300 (a)
QUEBEC					
Allard (P)	71	77	87	58	280,600 ac-ft
Gouin (P)	78	84	61	65	6,954,000 ac-ft
MAINE					
Seven reservoir systems (MP)	54	60	41	56	178,500 mcf
NEW HAMPSHIRE					
First Connecticut Lake (P)	63	66	21	74	3,330 mcf
Lake Francis (FPR)	73	76	83	78	4,326 mcf
Lake Winnipesaukee (PR)	82	86	47	57	7,220 mcf
VERMONT					
Harriman (P)	74	81	36	63	5,060 mcf
Somerset (P)	76	71	76	70	2,500 mcf
MASSACHUSETTS					
Cobble Mountain and Borden Brook (MP)	75	79	64	72	3,394 mcf
NEW YORK					
Great Sacandaga Lake (FPR)	61	63	43	56	34,270 mcf
Indian Lake (FMP)	107	92	75	59	4,500 mcf
New York City reservoir system (MW)	82	84	59	.....	547,500 mg
NEW JERSEY					
Wanaque (M)	91	96	42	66	27,730 mg
PENNSYLVANIA					
Allegheny (FPR)	37	32	32	32	51,400 mcf
Pymatuning (FMR)	98	95	85	78	8,191 mcf
Raystown Lake (FR)	68	64	65	43	33,190 mcf
Lake Wallenpaupack (PR)	59	75	59	51	6,875 mcf
MARYLAND					
Baltimore municipal system (M)	100	101	84	84	85,340 mg
SOUTHEAST REGION					
NORTH CAROLINA					
Bridgewater (Lake James) (P)	94	100	81	75	12,580 mcf
Narrows (Badin Lake) (P)	78	95	92	92	5,616 mcf
High Rock Lake (P)	70	66	30	55	10,230 mcf
SOUTH CAROLINA					
Lake Murray (P)	82	78	82	58	70,300 mcf
Lakes Marion and Moultrie (P)	72	79	71	62	81,100 mcf
SOUTH CAROLINA--GEORGIA					
Clark Hill (FP)	72	73	47	51	75,360 mcf
GEORGIA					
Burton (PR)	85	94	80	55	104,000 ac-ft
Sinclair (MPR)	97	97	76	70	214,000 ac-ft
Lake Sidney Lanier (FMPR)	61	63	37	50	1,686,000 ac-ft
ALABAMA					
Lake Martin (P)	84	78	76	59	1,373,000 ac-ft
TENNESSEE VALLEY					
Clinch Projects: Norris and Melton Hill Lakes (FPR)	37	38	26	31	1,156,000 cfsd
Douglas Lake (FPR)	51	49	16	16	703,100 cfsd
Hiwassee Projects: Chatuge, Nottely, Hiwassee, Apalachia, Blue Ridge, Ocoee 3, and Parksville Lakes (FPR)	60	60	39	41	510,300 cfsd
Holston Projects: South Holston, Watauga, Boone, Fort Patrick Henry, and Cherokee Lakes (FPR)	56	53	36	34	1,452,000 cfsd
Little Tennessee Projects: Nantahala, Thorpe, Fontana, and Chilhowee Lakes (FPR)	68	70	39	39	745,200 cfsd
WESTERN GREAT LAKES REGION					
WISCONSIN					
Chippewa and Flambeau (PR)	84	88	87	75	15,900 mcf
Wisconsin River (21 reservoirs) (PR)	60	78	74	63	17,400 mcf
MINNESOTA					
Mississippi River headwater system (FMR)	26	27	26	28	1,640,000 ac-ft
MIDCONTINENT REGION					
NORTH DAKOTA					
Lake Sakakawea (Garrison) (FIPR)	90	89	85	89	22,700,000 ac-ft
SOUTH DAKOTA					
Angostura (I)	90	91	85	72	127,600 ac-ft
Bell Fourche (I)	30	35	55	39	185,200 ac-ft
Lake Francis Case (FIP)	63	51	53	50	4,834,000 ac-ft
Lake Oahe (FIP)	86	83	83	.....	22,530,000 ac-ft
MIDCONTINENT REGION—Continued					
SOUTH DAKOTA—Continued					
Lake Sharpe (FIP)	103	103	103	93	1,725,000 ac-ft
Lewis and Clarke Lake (FIP)	102	95	93	91	477,000 ac-ft
NEBRASKA					
Lake McConaughy (IP)	73	76	61	68	1,948,000 ac-ft
OKLAHOMA					
Eufaula (FPR)	89	94	78	90	2,378,000 ac-ft
Keystone (FPR)	84	108	83	101	661,000 ac-ft
Tenkiller Ferry (FPR)	97	96	88	100	628,200 ac-ft
Lake Altus (FIMR)	62	60	43	46	134,600 ac-ft
Lake O'The Cherokees (FPR)	74	104	71	81	1,492,000 ac-ft
OKLAHOMA--TEXAS					
Lake Texoma (FMPRW)	92	92	84	92	2,722,000 ac-ft
TEXAS					
Bridgeport (IMW)	40	38	36	44	386,400 ac-ft
Canyon (FMR)	90	91	96	70	385,600 ac-ft
International Amistad (FIMPW)	123	123	138	84	3,497,000 ac-ft
International Falcon (FIMPW)	94	91	100	78	2,668,000 ac-ft
Livingston (IMW)	99	100	84	77	1,788,000 ac-ft
Possum Kingdom (IMPRW)	89	88	94	100	569,400 ac-ft
Red Bluff (PI)	23	23	33	28	307,000 ac-ft
Toledo Bend (P)	88	91	88	77	4,472,000 ac-ft
Twin Buttes (FIM)	43	41	62	29	177,800 ac-ft
Lake Kemp (IMW)	50	50	56	88	268,000 ac-ft
Lake Meredith (FMW)	29	29	35	38	821,300 ac-ft
Lake Travis (FIMPRW)	85	86	72	76	1,144,000 ac-ft
THE WEST					
WASHINGTON					
Ross (PR)	91	74	86	78	1,052,000 ac-ft
Franklin D. Roosevelt Lake (IP)	93	66	82	102	5,022,000 ac-ft
Lake Chelan (PR)	72	58	72	64	676,100 ac-ft
Lake Cushman	99	84	75	84	359,500 ac-ft
Lake Merwin (P)	105	101	96	90	245,600 ac-ft
IDAHO					
Boise River (4 reservoirs) (FIP)	38	41	61	52	1,235,000 ac-ft
Coeur d'Alene Lake (P)	56	38	42	54	238,500 ac-ft
Pend Oreille Lake (FP)	56	35	37	51	1,561,000 ac-ft
IDAHO--WYOMING					
Upper Snake River (8 reservoirs) (MP)	38	47	72	56	4,401,000 ac-ft
WYOMING					
Boysen (FIP)	79	78	83	79	802,000 ac-ft
Buffalo Bill (IP)	51	51	71	71	421,300 ac-ft
Keyhole (F)	77	76	78	44	190,400 ac-ft
Pathfinder, Seminoe, Alcova, Kortes, Glendo, and Guernsey Reservoirs (I)	54	55	51	45	3,056,000 ac-ft
COLORADO					
John Martin (FIR)	1	2	0	12	364,400 ac-ft
Taylor Park (IR)	78	76	55	52	106,200 ac-ft
Colorado–Big Thompson project (I)	65	65	42	54	722,600 ac-ft
COLORADO RIVER STORAGE PROJECT					
Lake Powell: Flaming Gorge, Fontenelle, Navajo, and Blue Mesa Reservoirs (IFPR)	83	81	66	.....	31,620,000 ac-ft
UTAH--IDAHO					
Bear Lake (IPR)	67	66	67	57	1,421,000 ac-ft
CALIFORNIA					
Folsom (FIP)	67	61	64	49	1,000,000 ac-ft
Hetch Hetchy (MP)	61	50	66	40	360,400 ac-ft
Isabella (FIR)	37	37	44	20	570,000 ac-ft
Pine Flat (FI)	50	53	64	38	1,001,000 ac-ft
Clair Engle Lake (Lewiston) (P)	67	68	71	68	2,448,000 ac-ft
Lake Almanor (P)	64	63	78	46	1,036,000 ac-ft
Lake Berryessa (FIMW)	64	64	69	74	1,600,000 ac-ft
Millerton Lake (FI)	35	37	50	39	503,200 ac-ft
Shasta Lake (FIPR)	73	75	76	63	4,377,000 ac-ft
CALIFORNIA--NEVADA					
Lake Tahoe (IPR)	11	7	9	46	744,600 ac-ft
NEVADA					
Rye Patch (I)	47	45	22	49	194,300 ac-ft
ARIZONA--NEVADA					
Lake Mead and Lake Mohave (FIMP)	85	86	82	68	27,970,000 ac-ft
ARIZONA					
San Carlos (IP)	76	76	21	12	1,073,000 ac-ft
Salt and Verde River system (IMPR)	76	76	80	34	2,073,000 ac-ft
NEW MEXICO					
Conchas (FIR)	43	43	26	77	352,600 ac-ft
Elephant Butte and Caballo (FIPR)	34	36	5	25	2,539,000 ac-ft

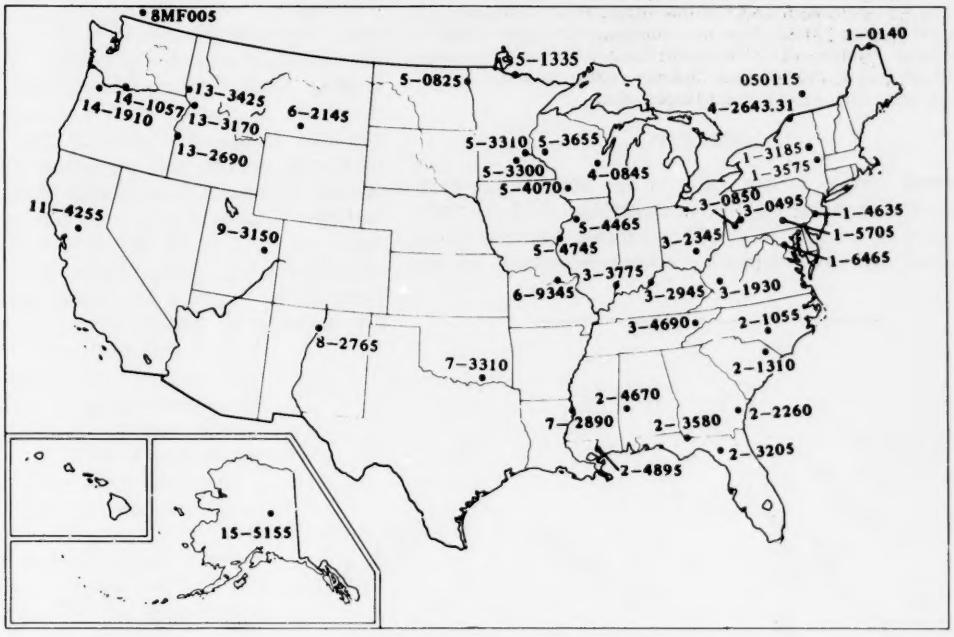
[a] Thousands of kilowatt-hours (the potential electric power that could be generated by the volume of water in storage).

FLOW OF LARGE RIVERS DURING NOVEMBER 1979

Station number*	Stream and place of determination	Drainage area (square miles)	Mean annual discharge through September 1975 (cfs)	November 1979					
				Monthly discharge (cfs)	Percent of median monthly discharge, 1941–70	Change in discharge from previous month (percent)	Discharge near end of month		
							(cfs)	(mgd)	Date
1–0140	St. John River below Fish River at Fort Kent, Maine	5,690	9,549	7,449	105	+20	10,400	6,720	29
1–3185	Hudson River at Hadley, N.Y	1,664	2,853	3,413	171	+25	14,000	9,050	30
1–3575	Mohawk River at Cohoes, N.Y	3,456	5,630	6,159	165	+110	.....	.....	.....
1–4635	Delaware River at Trenton, N.J	6,780	11,630	14,602	162	-9	22,000	14,200	27
1–5705	Susquehanna River at Harrisburg, Pa	24,100	34,200	43,700	208	+17	156,000	101,000	29
1–6465	Potomac River near Washington, D.C	11,560	[1] 11,190	16,920	407	-50	13,900	8,980	30
2–1055	Cape Fear River at William O. Huske Lock near Tarheel, N.C	4,810	5,007	9,320	400	+188	12,500	8,080	30
2–1310	Pee Dee River at Peedee, S.C	8,830	9,657	13,900	309	-1	11,800	7,630	26
2–2260	Altamaha River at Doctortown, Ga	13,600	13,780	7,724	165	-9	6,560	4,240	29
2–3205	Suwannee River at Branford, Fla	7,880	6,970	4,210	98	-35	4,000	2,600	30
2–3580	Apalachicola River at Chattahoochee, Fla	17,200	22,330	16,600	155	+12	25,900	16,700	30
2–4670	Tombigbee River at Demopolis lock and dam near Coatopa, Ala	15,400	22,570	33,320	576	+283	76,300	49,300	29
2–4895	Pearl River near Bogalusa, La	6,630	9,263	5,578	244	-3	22,000	14,200	30
3–0495	Allegheny River at Natrona, Pa	11,410	[1] 19,210	17,600	169	-27	39,700	25,700	27
3–0850	Monongahela River at Braddock, Pa	7,337	[1] 12,360	14,700	229	-42	53,300	34,400	27
3–1930	Kanawha River at Kanawha Falls, W.Va	8,367	12,530	21,730	330	+22	46,200	29,900	28
3–2345	Scioto River at Higby, Ohio	5,131	4,513	7,947	703	+59	26,000	16,800	26
3–2945	Ohio River at Louisville, Ky[2]	91,170	114,100	154,400	348	+4	260,000	168,000	27
3–3775	Wabash River at Mount Carmel, Ill	28,635	27,030	23,740	316	+112	67,400	43,600	30
3–4690	French Broad River below Douglas Dam, Tenn	4,543	[1] 6,794	14,300	410	+116	.....	.....	.....
4–0845	Fox River at Rapide Croche Dam, near Wrightstown, Wis[2]	6,150	4,185	3,830	135	+132	.....	.....	.....
02MC002 (4–2643.31)	St. Lawrence River at Cornwall, Ontario–near Massena, N.Y[3]	299,000	241,100	287,700	126	-1	281,000	182,000	30
050115	St. Maurice River at Grand Mere, Quebec	16,300	25,300	18,300	89	-46	24,600	15,900	30
5–0825	Red River of the North at Grand Forks, N. Dak	30,100	2,524	1,942	171	+24	1,600	1,030	30
5–1335	Rainy River at Manitou Rapids, Minn	19,400	12,950	9,620	101	+105	9,000	5,800	21
5–3300	Minnesota River near Jordan, Minn	16,200	3,412	6,500	778	+144	5,000	3,200	26
5–3310	Mississippi River at St. Paul, Minn	36,800	[1] 10,580	17,300	320	+146	13,100	8,470	26
5–3655	Chippewa River at Chippewa Falls, Wis	5,600	5,110	4,240	120	+22	.....	.....	.....
5–4070	Wisconsin River at Muscoda, Wis	10,300	8,613	8,700	146	+35	.....	.....	.....
5–4465	Rock River near Joslin, Ill	9,551	5,852	4,310	151	+21	4,450	2,880	30
5–4745	Mississippi River at Keokuk, Iowa	119,000	62,570	67,900	187	+60	70,300	45,400	30
6–2145	Yellowstone River at Billings, Mont	11,796	6,986	3,179	88	+5	2,780	1,800	30
6–9345	Missouri River at Hermann, Mo	524,200	79,750	66,170	151	+29	58,900	38,100	21
7–2890	Mississippi River at Vicksburg, Miss[4]	1,140,500	573,600	534,200	183	-4	651,000	421,000	26
7–3310	Washita River near Durwood, Okla	7,202	1,414	472	106	+221	250	160	30
8–2765	Rio Grande below Taos Junction Bridge, near Taos, N. Mex	9,730	724	308	73	+31	300	190	30
9–3150	Green River at Green River, Utah	40,600	6,366	1,882	74	+14	2,200	1,420	30
11–4255	Sacramento River at Verona, Calif	21,257	19,150	12,400	108	+17	18,000	11,600	27
13–2690	Snake River at Weiser, Idaho	69,200	18,170	11,890	84	+1	12,400	8,010	26
13–3170	Salmon River at White Bird, Idaho	13,550	11,290	3,859	75	+3	3,990	2,580	26
13–3425	Clearwater River at Spalding, Idaho	9,570	15,570	5,682	105	+54	11,700	7,560	26
14–1057	Columbia River at The Dalles, Oreg[5]	237,000	194,600	51,600	57	-16	.....	.....	.....
14–1910	Willamette River at Salem, Oreg	7,280	23,810	18,070	68	+152	38,830	25,100	26–30
15–5155	Tanana River at Nenana, Alaska	25,600	23,850	10,933	133	-36	10,000	6,500	30
8MF005	Fraser River at Hope, British Columbia	83,800	96,400	32,800	55	-34	27,600	17,800	28

[1] Adjusted.
[2] Records furnished by Corps of Engineers.
[3] Records furnished by Buffalo District, Corps of Engineers, through International St. Lawrence River Board of Control. Discharges shown are considered to be the same as discharge at Ogdensburg, N.Y. when adjusted for storage in Lake St. Lawrence.
[4] Records of daily discharge computed jointly by Corps of Engineers and Geological Survey.
[5] Discharge determined from information furnished by Bureau of Reclamation, Corps of Engineers, and Geological Survey.
*The U.S. station numbers as listed in this table are in a shortened form previously in use, and used here for simplicity of tabular and map presentation. The full, correct number contains 8 digits and no punctuation marks. For example, the correct form for station number 1–3185 is 01318500.

SELECTED STREAM-GAGING STATIONS ON LARGE RIVERS



Location of stream-gaging stations on large rivers listed in table on page 18.

WATER RESOURCES REVIEW

November 1979

Based on reports from the Canadian and U.S. field offices; completed December 11, 1979

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EXPLANATION OF DATA

Cover map shows generalized pattern of streamflow for November based on 20 index stream-gaging stations in Canada and 130 index stations in the United States. Alaska and Hawaii inset maps show streamflow only at the index gaging stations which are located near the points shown by the arrows.

Streamflow for November 1979 is compared with flow for November in the 30-year reference period 1941–70. Streamflow is considered to be *below the normal range* if it is within the range of the low flows that have occurred 25 percent of the time (below the lower quartile) during the reference period. Flow for November is considered to be *above the normal range* if it is within the range of the high flows that have occurred 25 percent of the time (above the upper quartile).

Flow higher than the lower quartile but lower than the upper quartile is described as being *within the normal range.* In the Water Resources Review the median is obtained by ranking the 30 flows of the reference period in their order of magnitude; the highest flow is number 1, the lowest flow is number 30, and the average of the 15th and 16th highest flows is the median.

The normal is an average (but not an arithmetic average) or middle value; half of the time you would expect the November flows to be below the median and half of the time to be above the median. Shorter reference periods are used for the Alaska index stations because of the limited records available.

Statements about *ground-water levels* refer to conditions near the end of November. Water level in each key observation well is compared with average level for the end of November determined from the entire past record for that well or from a 20-year reference period, 1951–70. *Changes in ground-water levels,* unless described otherwise, are from the end of October to the end of November.

The Water Resources Review is published monthly. Special-purpose and summary issues are also published. Issues of the Review are free on application to the Water Resources Review, U.S. Geological Survey, Reston, Virginia 22092.

HYDROLOGY AND GEOCHEMISTRY OF THERMAL SPRINGS OF THE APPALACHIANS

The abstract and illustrations below are from the report, *Hydrology and geochemistry of thermal springs of the Appalachians*, by W. A. Hobba, Jr., D. W. Fisher, F. J. Pearson, Jr., and J. C. Chemerys: U.S. Geological Survey Professional Paper 1044-E, 36 pages, 1979. This report may be purchased for $3.50 from Branch of Distribution, U.S. Geological Survey, 1200 S. Eads St., Arlington, VA 22202 (check or money order payable to U.S. Geological Survey); or from Superintendent of Documents, Government Printing Office, Washington, D.C. 20402 (payable to Superintendent of Documents).

ABSTRACT

Thermal springs in nine areas in the Appalachians from Georgia to New York (fig. 1) were studied in 1975 and 1976 using satellite imagery, local well and spring data, and results of current and early studies by other investigators. All the springs investigated discharge from folded and faulted sandstone or carbonate rocks in valley areas (figs. 2, 3). Where geologic structure is relatively uncomplicated, ground water discharging from thermal springs probably has circulated to great depths roughly parallel to the strike of the bedding and has moved upward rapidly where a fault or faults cross the bedding. Hydrologic and chemical data suggest that most of the water discharging from warm springs in the Devonian Oriskany Sandstone is derived from recharge entering and circulating through that formation. The temperature of the thermal springs can be accounted for by "normal" geothermal heat flow if water circulates to minimum depths of 250–1,600 meters along paths of sufficient length and contact area to absorb enough geothermal heat to raise the temperature of the water to that required to produce the given thermal springs. The discharge at springs where temperature fluctuates very little is primarily water from deep circulation. The discharge at springs where temperature fluctuates widely is warm water mixed with variable proportions of shallow-circulating cool water. (See fig. 4.)

Observed temperatures of the warm springs range from 18° to 41°C; the highest chemical thermometer temperature is 84°C. Agreement among observed, chalcedony, and cation temperatures of the warmest springs suggests reservoir temperatures of 30°–50°C. Dissolved helium, arsenic, potassium, and $\delta^{18}O$ are considered as geothermal indicators. Tritium analyses are used to calculate fractions of old and modern components of mixed waters. Computer calculations of carbonate saturation indices show (1) considerable undersaturation in silica-rock warm spring waters and (2) carbonate equilibrium in the limestone and dolomite thermal waters. Better values of saturation indices are obtained when analyzed carbon dioxide rather than field pH is used in the computer input data. A method is described for adjusting $\delta^{13}C$ to correct for carbon dioxide outgassing from water samples.

Figure 1.—Map showing the region in which the nine thermal springs areas, described in the report, occur.

Figure 2.—Possible movement of ground water through a faulted and fractured anticlinal ridge bordered by a synclinal ridge. Aquifer has impermeable boundary at 1,500 m depth. Flow pattern is in a vertical plane normal to the strike of the rocks.

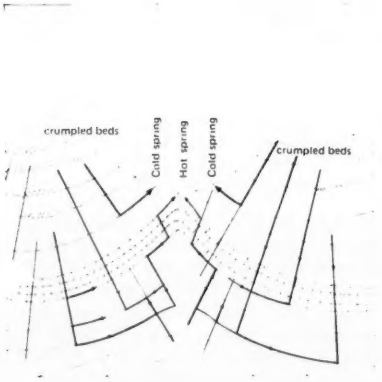

Figure 3.—Possible movement of ground water through a multilayered folded, faulted, and fractured aquifer such as those in Warm Springs Valley, Va. Much of the flow (not indicated by arrows) is into the figure and upward beneath the hot spring.

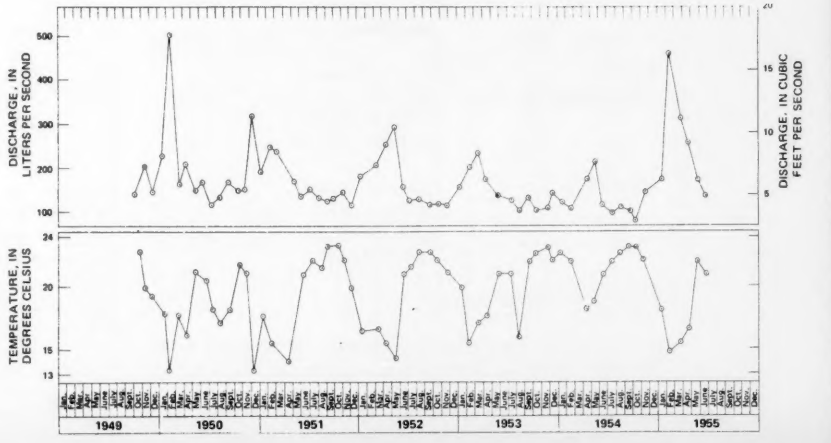

Figure 4.—Temperature and discharge of Bolar Spring at Bolar, Va. The generally inverse relationship between discharge and temperature indicates that the spring water probably is a mixture of deep circulating warm water and shallow circulating cool water.